

# Aligning word senses and more: tools for creating interlinked resources in historical loanword lexicography

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## Abstract

This paper presents a dictionary writing system developed at the Institute for the German Language in Mannheim (IDS) for an ongoing international lexicographical project that traces the way of German loanwords in the East Slavic languages Russian, Belarusian and Ukrainian that were possibly borrowed via Polish. The results will be published in the *Lehnwortportal Deutsch* (LWP, [lwp.ids-mannheim.de](http://lwp.ids-mannheim.de)), a web portal for loanword dictionaries with German as the common donor language. The system described here is currently in use for excerpting data from a large range of historical and contemporary East Slavic monolingual dictionaries. The paper focuses on the tools that help in merging excerpts that are etymologically related to one and the same Polish etymon. The merging process involves eliminating redundancies and inconsistencies and, above all, mapping word senses of excerpted entries onto a common cross-language set of ‘metasenses’. This mapping may involve literally hundreds of excerpted East Slavic word senses, including quotations, for one ‘underlying’ Polish etymon.

**Keywords:** dictionary writing system; historical lexicography; word senses

## 1. Introduction

An ongoing international lexicographical project<sup>1</sup> of the Institute of Slavic Studies at the University of Oldenburg and the Institute for the German Language (IDS, Mannheim) traces the way of German loanwords in Polish – as recorded in the *Dictionary of German Loanwords in Standard and Written Polish* (DGLP) – into the East Slavic languages Russian, Belarusian, and Ukrainian. The results will be published in three separate but interlinked dictionaries alongside the already republished DGLP in the *Lehnwortportal Deutsch* (LWP), a web portal for loanword dictionaries with German as the common donor language.<sup>2</sup> This endeavor draws on a rich Slavic tradition of historical lexicography; a wealth of partially unpublished

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<sup>1</sup> The project is funded by the German Research Foundation (DFG); it started in mid-2013 and will be completed in 2017.

<sup>2</sup> The LWP aims to provide a uniform access layer to a growing number of heterogeneous lexicographical resources, allowing queries for arbitrarily complex borrowing constellations across all component dictionaries (Meyer, 2013), even in chains of borrowing processes (Meyer, 2014a).

dictionary material is currently being excerpted and analyzed both in Oldenburg and at the editorial offices of those dictionaries that are still works in progress, while the IT architecture development and the integration of the resulting dictionaries with an estimated total of more than 1900 new entries into the LWP is carried out in Mannheim.

Section 2 of the present paper will give a brief sketch of the project's main tasks, the lexicographical process and the resources involved. The focus of the paper is on *wdlpOst*, the dictionary writing system developed at the IDS Mannheim for the specific purposes of the project. A high-level overview of the *wdlpOst* system, its functionality and its data architecture is given in section 3. Section 4 focuses on one of the central advanced features of the system, an editing tool which allows lexicographers to map the widely differing word sense distinctions found in the various East Slavic sources for corresponding headwords onto a common semantic scheme. The closing section 5 gives a brief overview of some further tools of the dictionary writing system.

## 2. Lexicographical Process: Resources and Workflow

The project's main task consists of extracting and processing lexicographical information on potential Polish-mediated German loanwords in East Slavic from a range of (at present) 15 East Slavic *source dictionaries*, i.e. historical and contemporary monolingual dictionaries of Russian, Ukrainian, and Belarusian. In view of the wealth of data already collected through a number of long-term lexicographical projects and documented in multi-volume dictionaries, no attempt is made to collect new corpus material. The excerpted lexicographical data covers a time span from the eleventh century until the present day and reflects a wide range of lexicographical traditions and approaches. In most cases, the source dictionaries do not indicate the status of words as loans or inherited. Therefore, the excerpted entries must be evaluated in a cross-linguistic perspective in order to formulate hypotheses of possible borrowing pathways. The excerpts are then used to compile entries of the three *target dictionaries* for 'indirect' German loanwords in East Slavic languages that constitute the project's primary scientific outcome and will form part of the loanword dictionary portal LWP.

The project's lexicographical work is directed and mainly carried out at the University of Oldenburg; unpublished parts of four multi-volume historical dictionaries (SRJa11-17, SRJa18, HSBM, SUM16-17) are excerpted from paper slips at the *editorial offices* of these dictionary projects in Moscow (for the SRJa11-17), Saint Petersburg (for the SRJa18), Minsk (for the HSBM), and Lviv (for the SUM16-17).

The project does not intend to perform an exhaustive search for possible German loanwords in the source dictionaries, as this simply would not have been a manageable task for a small three-year project. Instead, the point of departure is defined by the

German loanwords in Polish that are listed in the authoritative dictionary on this topic, the DGLP, whose more than 2400 entries are explicitly restricted to German etyma inherited from Germanic – thus in particular excluding German etyma of Latin or Greek origin – and borrowed directly into written and Standard Polish. The lexicographical process can roughly be divided into four overlapping stages:

- 1. *Exploratory phase* (Oldenburg, editorial offices): All source dictionaries are systematically scanned for *source entries* whose headwords are possible East Slavic cognates of Polish loanwords in the DGLP (including variants and derivatives of these Polish loans). These source entries are tabulated with some basic information in simple spreadsheet tables. No decisions on borrowing pathways, loanword status, etc. are made at this point. This phase is finished and has yielded a total of more than 9000 source entries.
- 2. *Excerpt phase* (Oldenburg, editorial offices): Each source entry listed in the spreadsheet tables is turned into an initially almost empty *excerpt* represented as an XML document and stored either in a central database located on an IDS server, or, in the case of the editorial offices where a reliable Internet connection is not always available, in a local computer directory with the option to make periodic backups on the server. The excerpt documents are then filled out using the *wdlpOst* editing system described below in section 3. Excerpts conform to standard practices in historical lexicography and are structured in a similar manner as DGLP entries, listing graphemic and phonemic variants, word senses, and derivatives (including compounds) with their respective variants. Variants and word senses are systematically documented with dated quotations to the extent that such data are available. During the excerpt phase, and even afterwards, new candidates for loanwords may be found and subsequently added to the stock of source entries in an iterative process. Such new candidates can sometimes even be looked for in a systematic and extrapolative way by searching for words in an East Slavic language Y that from the point of view of historical phonology (and possibly semantics) closely correspond to known loanwords in another East Slavic language X. A typical example would be the search for Y-correlates of verbal prefixation formations already found for a certain verb stem in X.
- 3. *Compilation phase* (mainly Oldenburg): The often numerous excerpts of source entries on a Russian, Belarusian or Ukrainian lexeme are evaluated philologically and their data is merged into new XML documents, the *target entries* of the newly compiled Russian, Belarusian, and Ukrainian target dictionaries. In this phase, occasional or systematic additional inquiries at the editorial offices are still possible. In some cases, this might include requests for additional information on entries already published, e.g. on first quotations not included in print, but documented on the paper slips. The estimated number of entries will be around 2000. This amalgamation process is far from trivial and is significantly sped up by specific software tools in the *wdlpOst* editor. The most important one of these tools deals with word senses and will be presented below in section 4.

- 4. *Integration phase* (Oldenburg): Target dictionary entries on cognate words from Russian, Belarusian, and Ukrainian are re-examined philologically and from the point of view of historical linguistics; the results are documented as a cross-entry commentary that focuses on the possible and probable borrowing relationships and is supplemented by a visualization of possible borrowing pathways.

### 3. The Dictionary Writing System *wdlpOst*

For the specific purposes of the project a complex in-house server-based dictionary writing system named *wdlpOst* has been developed at the IDS. *wdlpOst* allows lexicographers to collaboratively edit excerpt documents and compile target entries in the stages 2 to 4 mentioned above. The following is a list of notable features and properties of *wdlpOst*:

- The system is based on a collaborative server/client infrastructure. In the default network mode, a desktop client application (henceforth, the *editor*) communicates via the Internet with a web service that in turn performs create/read/update/delete operations, mainly concerning XML documents, on a relational (Oracle) database management system.
- The web service is protected by strong cryptography (using digital signatures) and takes care of many validations, reporting and backup tasks including a locking mechanism for mutually exclusive access to individual excerpts and target entries.
- The desktop client (editor) operates with an underlying object-oriented data model. XML is used merely for serialization, i.e. for external storage purposes; for details, see Meyer (2014b).
- Client and server software is written in the Java and Groovy programming languages; in particular, this implies that the *wdlpOst* editor is a cross-platform desktop application.
- The client's user interface (GUI) is fully bilingual (German and Russian).
- The *wdlpOst* editor has an offline mode used, as stated above, in the editorial offices to fill out excerpt documents that are stored on the local hard disk. With a mouse click, all data edited so far can be sent to the server whenever Internet connectivity is available.
- For the editor, there are several special 'restricted input modes' that allow student assistants to fill in specific types of information excerpted from dictionaries without the danger of interfering with other entry parts.
- The editor features a live preview and automatic live validation of excerpts and target entries.
- There is a simple server-based source management system that provides a minimum of consistency for abbreviations and dates of quotation sources.

- The date input dialog used for quotations offers sophisticated options to specify ‘fuzzy’ dates where exact data are not available (such as ‘last third of 15<sup>th</sup> century’) and to distinguish between the dating of a historical source and the dating of the publication a quotation was taken from.
- The editor offers a system of drop-down menus as well as keyboard shortcuts for a large number of special characters of various scripts to be found especially in East Slavic historical dictionaries.
- There are currently three advanced search options available for queries on the project’s data: structured full-text search, XPath-based queries and an interface that presents the totality of the XML documents as a standard relational database with about 40 tables.

The *wdlpOst* system has been in productive use for excerpting data from the source dictionaries since mid-2014.

Figure 1 (below) shows a screenshot of the editor’s main window.

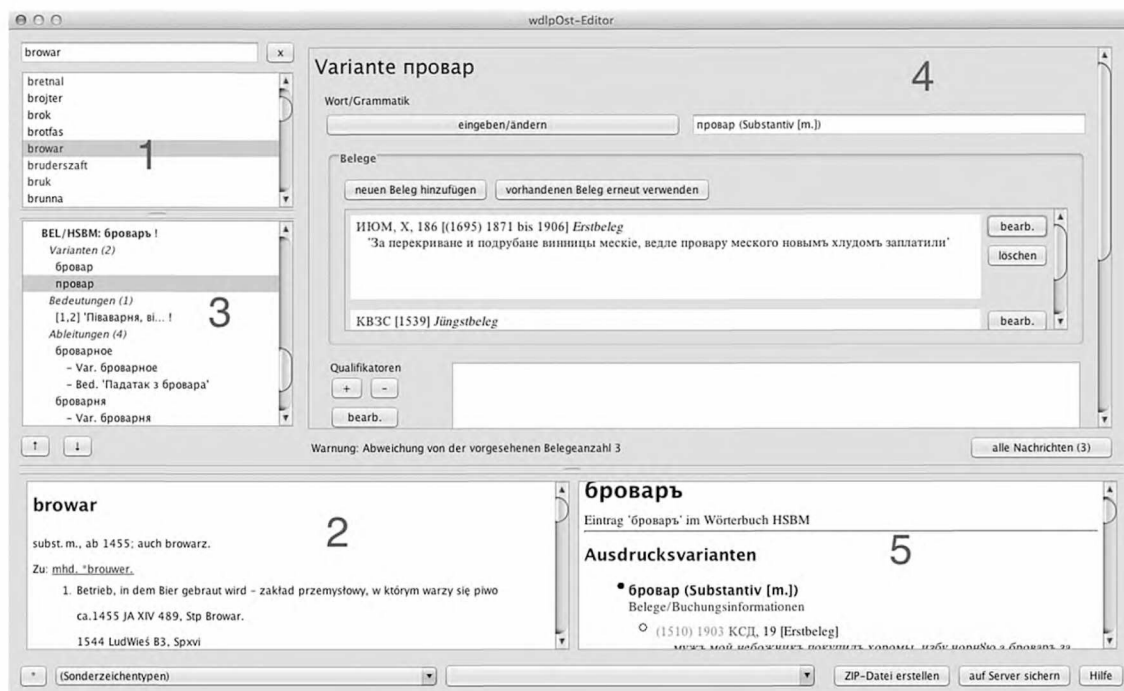


Figure 1: Main editing window of the *wdlpOst* desktop client

The Polish lemmas (and other recorded words such as derivatives as well as their meaning definitions) of the DGLP serve as a common frame of reference for all lexicographical work with the editor. Internally, the editor uses the full XML representation of the DGLP entries for various cross-referencing tasks. As a first step, the working lexicographer must select a Polish headword from the DGLP such as *browar* ‘brewer; brewery’ (from Middle High German *brouwer* ‘brewer’) in an alphabetical lemma list (1). A preview of the corresponding DGLP entry is displayed for quick reference in the main window (2). The central navigational device of the

editor is a list of all excerpts of East Slavic source entries that etymologically ‘belong’ to the DGLP entry selected, i.e., whose lemmas are considered loans from the DLGP lemma or one of its Polish derivatives or at least share their German etymon with it (3). The internal structure of each excerpt is indicated in a tree-like fashion below the headword. Figure 2 shows a part of the navigation list for Polish *browar* ‘brewer(y)’. Two still incomplete excerpts from source entries of different dictionaries can be seen in the image; the upper one concerns the entry *brovar* in the Ukrainian historical dictionary SUM16-16 and features two phonologically distinct variants, two word senses, two derivatives (each of them with one graphemic variant and one word sense) and zero competing near-synonyms.

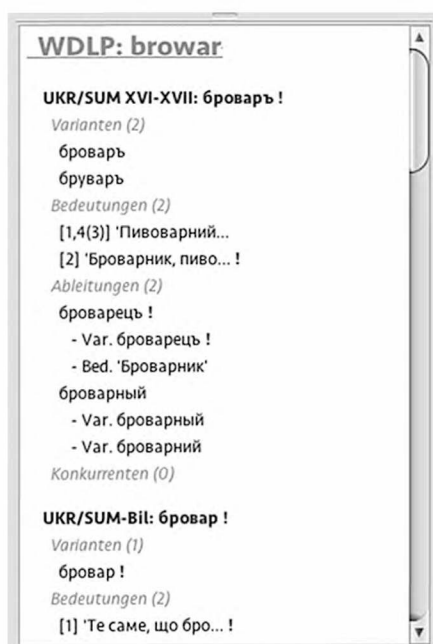


Figure 2: The editor’s navigation tree for a given DGLP headword (here: *browar*)

Clicking on a tree item (e.g., on one of the variant forms) opens the corresponding input panel (4) used for entering all pertinent lexicographical information, including an arbitrary number of records and quotations for a variant or word sense. The excerpt data is presented in a live preview HTML window (5).

#### 4. Merging and Compiling: The Word Sense Mapping Tool

As noted above, the process of merging excerpts of different source entries on the same word during the ‘compilation phase’ is philologically, lexicographically and linguistically difficult: The excerpted source dictionaries (which usually cover different periods of the language) may or may not have different lemmatizations and microstructures, use incompatible word sense distinctions at distant points in the lumping-splitting continuum; there are several differing, partially historical spelling traditions; a lot of diasystematic variation on both the phonological and the morphological level is to be expected; and so on. In addition, there will usually be a lot

of duplicate and sometimes even contradictory information from the various sources. As a consequence, the *wdlpOst* editor includes dedicated tooling for eliminating redundancies and inconsistencies, pruning quotation lists, and other tasks. One of the most important tools, the *metasense editor*, serves to map word senses of excerpted source entries related to one and the same DGLP lemma onto a common cross-language set of ‘metasenses’. These metasenses are the word senses that are actually listed in the target entries for the German loanwords in East Slavic. Each metasense in a target entry is supplemented with the quotations, dates, and definitions of all those word senses in the various dictionaries that have been mapped onto it.

Mapping corresponding word sense information in multiple dictionaries is a well-studied lexicographical problem; cf. Jackson (2002: 91) for a typical textbook example. For the project’s ‘compilation phase’, such mapping is a vital step in operationalizing the investigation of the sometimes involved and even sense-specific borrowing history of words across dictionaries. A German word might have been borrowed multiple times into one or more of the East Slavic languages, each time on a different borrowing pathway (e.g., into Ukrainian either via Polish or via Polish and Russian or directly from German), with correspondingly differing phonological implications and, most importantly, in differing word senses. A careful examination must be based on all available data, i.e. semantics and phonology of all attested variants together with dates of the first and, possibly, last attestations of the different variants.

The need to define, for a set of cognate target dictionary entries, a cross-dictionary spectrum of word senses, is, as a consequence, of a practical nature. The mapping serves a twofold purpose, providing, on the one hand, the word senses of the target entries and, on the other hand, a tool for language contact research. Due to the convoluted history of the contemporary standard East Slavic languages and their common origin in a continuum of closely related dialects (cf. Müller & Wingender, 2013), it is important to be able to identify word senses of cognates across languages. This means that the same set of metasenses should be applied across all three languages.

As a consequence of this ‘instrumentalist’ understanding of the word sense mapping process, well-known important theoretical objections to ‘reifying’ word senses (cf. Hanks, 2000) do not apply in the context of the project described here. On a side note it is not a realistic goal to automate the matching process. There do exist several NLP-based proposals for this task (cf. Ide & Véronis, 1990) but they are geared towards tasks such as optimizing information extraction from multiple dictionaries for the purpose of creating lexical knowledge bases and thus cannot be expected to work well in a multilingual and diachronic setting that requires human philological expertise.

As already indicated in section 3, each (excerpt of) a source entry *E* is linked to a



DGLP entry  $P$ .<sup>3</sup> In the ‘excerption phase’, the lexicographer specifies, for each word sense  $W$  given in  $E$ , which word senses of  $P$  (if any) match  $W$  completely and which word senses of  $P$  (if any) match  $W$  only partially or potentially. Henceforth, this specification will be called the *DGLP profile* of the excerpted East Slavic word sense definition. Here, matching of an East Slavic word sense  $W$  with a DGLP word sense  $W'$  ideally means that the intension related to  $W$  is included in the intension related to  $W'$ . In practice, this is a rough and ready method to intuitively and preliminarily classify word sense definitions given the sparse information available. As we shall soon see, the results of this classification are used in the ‘compilation phase’ as a handy heuristic that aids in establishing metasenses.

Figure 3 shows the dialog window used in the editor for the classification procedure. In the hypothetical example shown, the East Slavic word sense definition in question is marked as completely matching sense nr. 1 ‘beer brewery’ and nr. 3 ‘suspicious, unpleasant place’ of the Polish lemma (here, *browar* ‘brewer(y)’) and potentially matching nr. 6 ‘pub’. This DGLP profile is abbreviated as [1,3(6)] throughout the editor. Note that the numbering of the DGLP word senses as well as the German and Polish sense definitions are taken from the original DGLP entries.

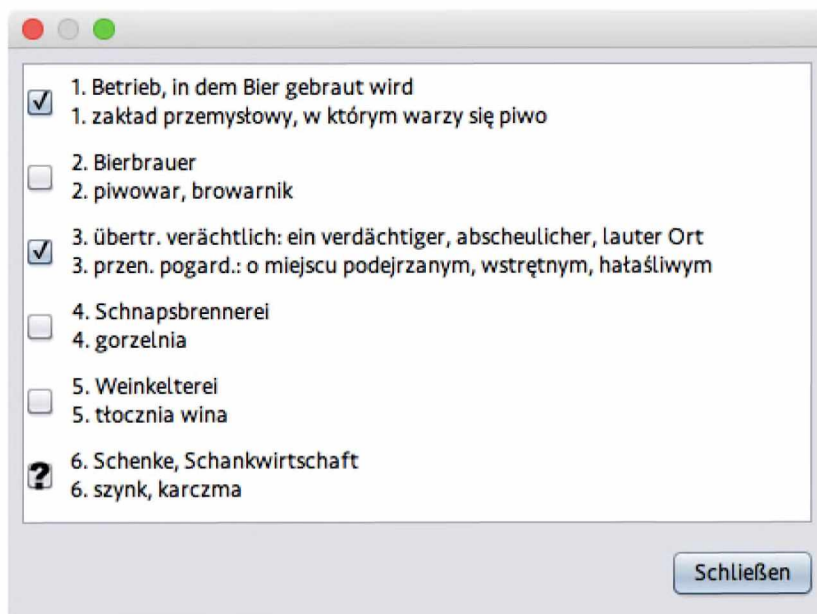


Figure 3: Dialog for assigning a DGLP word sense profile

The metasense editor, to which we now turn, gives the lexicographer a complete overview of all word senses in the excerpted source entries that have been assigned (linked) to a selected DGLP entry. In complicated cases with highly polysemous words there might easily be more than a hundred such word sense definitions, each of which with its own DGLP profile.

<sup>3</sup> More precisely, the East Slavic lemma must explicitly be linked to either the lemma or one of its Polish derivatives or compounds as listed in the DGLP entry.



Figure 4 (below) shows the main dialog of the metasense editor, displaying the entirety of excerpted word senses in East Slavic source entries with associated Polish loanword *waga* ‘scales’, which has no less than 24 word senses in the DGLP.

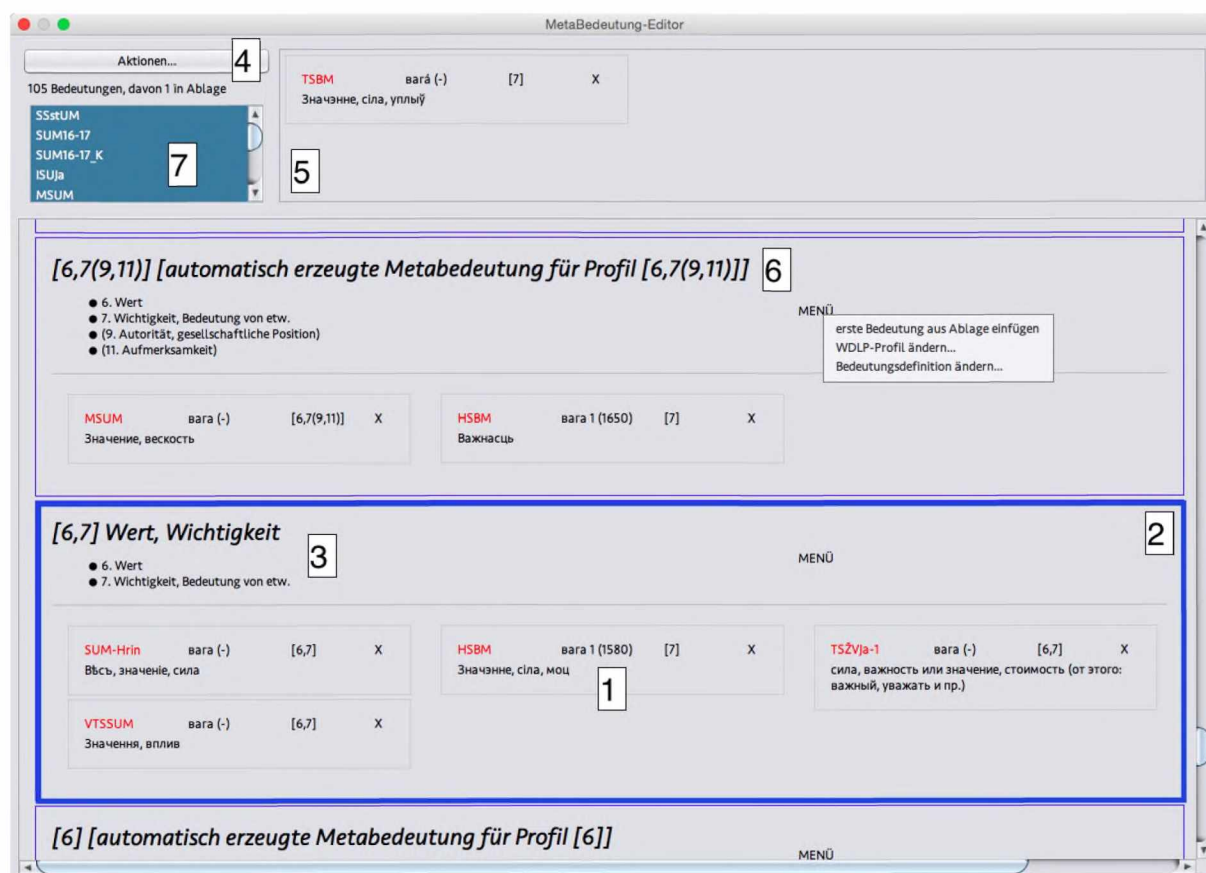


Figure 4: The metasense editor’s main window

Individual word senses as excerpted from source entries are the basic building blocks of the metasense editor. They are visually represented as ‘index cards’ like the one tagged with (1), shown enlarged in Figure 5. The index card contains the complete excerpted definition alongside the conventional abbreviation of the source dictionary, the lemma of the containing source entry in this dictionary, the date of first attestation of the word sense, and the DGLP profile. Double-clicking on the definition opens a window with full information on the word sense excerpt, including quotations and dates.

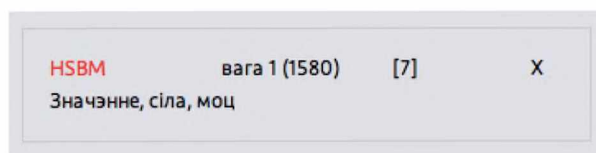


Figure 5: An index card for the word sense ‘meaningfulness, power’ recorded in the source entry *waga 1* of the dictionary HSBM, with DGLP profile [7]

All index cards that are assigned to a certain metasense are enclosed in an outlined rectangle such as the one indicated in Figure 4 with a broad line (2). They are arranged in three columns according to the object language of the source dictionaries

(from left to right: Ukrainian, Belarusian, Russian) and, per default, sorted by dictionary and first attestation date.

Each metasense rectangle has a caption (3) showing both the (German) definition of the metasense (in the case of (3), ‘value, importance’) and its DGLP profile. Through an action menu (4) the lexicographer can define new metasenses as needed, specifying their definitions and their DGLP profiles. The latter ones will be shown as an additional orientation in the target entries of the loanword dictionary portal LWP. A metasense DGLP profile is independent of the DGLP profiles associated with the index cards belonging to it; in addition, different metasenses may have identical DGLP profiles. In particular, East Slavic loanwords might have word senses not found in the Polish cognate loanword; all such word senses have an ‘empty’ DGLP profile. There is a dedicated action menu button for each metasense that permits users to, amongst other things, reassign all its index cards (excerpted word senses) to another metasense or to simply delete the metasense. The editor will issue a warning whenever two metasenses have overlapping profiles.

At the beginning of the metasense editing process for a given DGLP lemma, only one default rectangle is shown in the editor that does not represent a metasense but simply contains the set of all index cards not yet assigned to any proper metasense. Index cards can be ‘cut’ from their containing metasense rectangle and thereby placed on the clipboard (5), from which they can be reassigned to another metasense by double-clicking on its rectangle’s metasense caption.

The DGLP profiles associated with the excerpted word senses can be used to ‘automatically’ create metasenses for all index cards of a select range of source dictionaries that are not assigned to an already defined metasense yet. This is accomplished by assigning all pertinent index cards with identical DGLP profiles to a newly generated metasense such as (6) having that same DGLP profile and a placeholder definition like ‘automatically created metasense with profile X’. This procedure is one of the main *raisons d’être* for the DGLP profiles. The automatic creation process can be initiated through the global actions menu (4) which offers various additional operations such as deleting all metasenses or ‘unassigning’ all of its index cards. It is possible to ‘clone’ an index card and assign the clone to another metasense. This is useful in cases where a word sense definition in an excerpt matches more than one metasense.

During the construction of the metasense spectrum, it is sometimes useful to have the system display only index cards for selected dictionaries (7). In addition, the editor can display which DGLP word senses are not part of any index card or metasense profile yet and optionally create, for any user-selected DGLP word sense  $x$ , a corresponding metasense that all index cards with profile  $[x]$  are automatically assigned to.

From the above explanations it follows that there is a many-to-many relationship

between excerpted word senses and metasenses. This relationship is not encoded in the excerpts' XML documents but is represented in separate relational database tables. The approach outlined here strives for maximum generality. It would have been much simpler, yet philologically unfeasible, to simply take the DGLP word senses as the *tertium comparationis* for classifying East Slavic word senses: Sometimes the sense distinctions in DGLP loanwords might be too fine-grained, sometimes too coarse for the task at hand.

## 5. Outlook and conclusion

Several other editor tools for the 'compilation phase' are currently under development. In particular, there will be a 'metavariant editor' that assists the lexicographer, in a fashion similar to the metasense editor, in constructing a cross-dictionary and cross-language system of the graphemic/phonemic variants of all the East Slavic cognates of a Polish loanword in the DGLP. The main purpose of this tool is (a) to abstract from irrelevant spelling variation found in dictionaries of the same language and, additionally, (b) to identify words across Slavic languages that are, from the point of view of diachronic and contact phonology, 'equivalents' of each other (show regular or at least very frequent and typical correspondence patterns for all phonemes), such as Polish *rynek*, Russian *rynok*, Ukrainian *rynok*, Belarusian *rynak*. A similar tool will be available for the derivative forms of East Slavic loanwords.

All of these tools help lexicographers to create synoptic and slightly abstractive representations of certain aspects (lexical semantics, (mor)phonology) of cognate loanwords across the four languages involved. These representations are a useful point of departure for the linguistic assessment of the exact borrowing history of East Slavic loanwords with a German origin. Condensed, tabular versions of these representations will be part of the final target entries; they essentially display, for all four Slavic languages, the dates of the first and – where applicable – last attestation of the metasenses or metavariants at hand. More important, though, is another function of the synopses created by these tools: They make it possible to define the semi-automatic merging process whereby the lexicographical data from a potentially large range of excerpts can be amalgamated to form a target entry. When all synopses are created, the working lexicographer must select those 'metavariants' that he considers to be subsumable under one East Slavic target headword; the *wdlpOst* system can then automatically generate a complete draft version of the target entry, taking into account all metasenses and 'metaderivatives' associated with the metavariants chosen and incorporating all pieces of information from the excerpted dictionaries that are mapped to these meta-items.

This paper has focused on one aspect of the more general conceptual question of how a dictionary writing system can assist in creating cross-linking information between the three layers of lexicographical data involved in the project described here, i.e. the DGLP entries on Polish loans from German; the excerpted data from East Slavic

source dictionaries; and the East Slavic target entries. The intricate lexicographical, linguistic, and technical problems discussed above have let it seem, *pace* de Schryver (2011), unfeasible to simply customize an off-the-shelf dictionary writing system or an XML-editor based software solution; see Meyer (2014a, b) for more detailed argumentation. On the other hand, as is typical of projects in modern electronic lexicography, the in-house software solutions created as a response to this situation also do not lend themselves to easy generalization or abstraction beyond the confines of the very specific project they have been built for.

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